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(54) Title of the Invention: ARC POWER SUPPLY DEVICE

(21) Application No.: S63-42690

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Specification

1. Title of the Invention: ARC POWER SUPPLY DEVICE

2. Scope of Patent Claims

(1) An arc power supply device equipped with:

an input rectifying unit that rectifies input alternating current and converts it into direct current;

a reactor and a semiconductor switching element that are established in series between the direct current output terminals of said input rectifying unit;

a smoothing condenser unit into which the voltage of the connection point of said reactor and said switching element is inserted through a backflow prevention diode;

a high frequency converting unit that converts the smooth output of said smoothing condenser unit into high frequency alternating current;

an output rectifying/smoothing unit that rectifies and smoothens said high frequency alternating current and feeds it to the arc load;

a voltage detector that detects the smooth voltage of said condenser unit, and;

a control unit that feeds drive signals for high frequency switching to said switching element based on the detector signals and reference signals of said detector, and regulates said smooth voltage to a constant voltage.

3. Detailed Description of the Invention

(Industrial Field of Application)

The present invention relates to an arc power supply device to be placed in an arc device that can be driven with multiple input alternating currents with different voltages.

(Prior Art)

Conventionally, in arc devices such as arc welding machines and arc fusion machines that can be driven

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3. Detailed Description of the Invention

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The present invention relates to an arc power supply device to be placed in an arc device that can be driven with multiple input alternating currents with different voltages.

(Prior Art)

Conventionally, in arc devices such as arc welding machines and arc fusion machines that can be driven

with both 100V or 200V commercial alternating current power supplies, arc power supply devices having the structure shown in Figure 2 are established as constant current controlled direct current power supply devices, for example.

In Figure 2, (1) and (2) represent a pair of alternating current input terminals that are connected to a 100V or 200V single phase alternating current power supply. (3) and (4) are 2 input changing switches that are switched simultaneously. These are formed from 2-contact point changeover switches having 100V contact points (a) and (a)' and 200V contact points (b) and (b)', and the changeover pieces are connected to input terminal (1).

(5), (6), (7), and (8) are 4 diodes that rectify the input alternating current of input terminals (1) and (2). The cathode of diode (5) and the anode of diode (6) are connected to input terminal (1), and the cathode of diode (7) is connected to the cathode of diode (6). The cathode and anode of diode (8) are respectively connected to the anode of diode (7) and the anode of diode (5), and the connection point of the anode of diode (7) and the cathode of [handwritten: diode] (8) is connected to contact point (b) of switch (3). These form an input side rectifier that performs 100V double voltage rectification and 200V full wave rectification.

(9) and (10) are 2 condensers for smoothing that are connected in series. The series circuits of both condensers (9) and (10) are established in parallel in the series circuits of diodes (7) and (8), and the connection point of both condensers (9) and (10) is connected to the contact point of switch (3). (11) and (12) are 2 resistors for voltage equalization that are established in parallel on condensers (9) and (10), respectively, and together with condensers (9) and (10), they form an input side smoothing circuit.

(13) and (14) are 2 NPN-type switching transistors, and the emitter of transistor (13) and the collector of transistor (14) are connected. The collector of transistor (13) is connected to the connection point p of the cathodes of diodes (6) and (7), and the emitter of transistor (14) is connected to the connection point n of the anodes of diodes (5) and (8).

(15) is a transformer for high frequency output that is equipped with a primary winding (15a) and a secondary winding (15b) with an intermediate tap. One end of primary winding (15a) is connected to the connection point of transistors (13) and (14) through condenser (16) for direct current elimination, and the other end of primary winding (15a) is connected to the connection point of condensers (9) and (10).

(17) and (18) are 2 diodes that form an output side rectifier, and the anodes are respectively connected to both ends of secondary winding (15b). (19) is a reactor for smoothing with one side that is connected to the cathodes of diodes (17) and (18), and (20) is the object to be processed, which is connected to the other end of reactor (19). (21) is a torch electrode that forms the arc load along with the object to be processed (20), and it is connected to the intermediate tap of secondary winding (15b) through current detector (22).

(23) is an inverter drive circuit that outputs high frequency switching driver signals between 1 and 20KHz to the bases of transistors (13) and (14). Contact point signals of activation switch (24) and current detector signals of detector (22) are inputted, and the start and finish of the drive control of transistors (13) and (14) are controlled based on the contact signals of switch (24). The switching of transistors (13) and (14) are controlled based on the detector signals of detector (22), and the feedback of the load current that carries the arc load is kept at a constant current.

(25) is the power supply transformer of driver circuit (23) that is equipped with a primary winding (25a) with an intermediate tap and a secondary winding (25b). The intermediate tap and one end of primary winding (25a) are respectively connected to contact points (a)' and (b)' of switch (4), and the other end of primary winding (25a) is connected to input terminal (2). Furthermore, both ends of secondary winding (25b) are connected to driver circuit (23).

Based on the 100V and 200V of input alternating current fed to input terminals (1) and (2), switches (3) and (4) are switched to contact points (a) and (a)' or contact points (b) and (b)' in advance through manual operations.

In other words, in the case in which the input alternating current is a 100V power supply alternating current, switches (3) and (4) are switched to contact points (a) and (a)'. The input alternating current is double-voltage rectified and converted into direct current through the full wave double voltage rectification of diodes (5) and (6) and condensers (9) and (10), and a 290V (100V × 2 × 2) direct current voltage is generated between connection points p and n.

As the direct current voltage between connection points p and n is applied to the series circuits of transistors (13) and (14), transistors (13) and (14) are switched to high frequencies opposite to one another due to driver signals of driver circuit (23), and a high frequency voltage is applied to primary winding (15a) through condenser (16).

Furthermore, while a high frequency alternating current is induced in secondary winding (15b) based on the high frequency applied voltage of primary winding (15a), the high frequency alternating current of secondary winding (15b) is rectified and smoothed by diodes (17) and (18) and reactor (19), and direct current output is fed to the object to be processed (20) and torch electrode (21) arc load.

Moreover, the load current that carries the arc load is detected by detector (22), and a detector signal that is proportional to the load current is outputted from detector (22) to driver circuit (23).

Incidentally, driver circuit (23) operates based on the output direct current of secondary winding (15b), and it starts the drive control of transistors (13) and (14) according to the input of the contact signals of the activation operation of switch (24).

In order for the detector signals of detector (22) to agree with the reference signals that are internally configured, driver circuit (23) controls the switching frequencies of transistors (13) and (14), and the feedback of the load current is kept at a constant current.

On the other hand, in the case in which the input alternating current is a 200V power supply alternating current, switches (3) and (4) are switched to contact points (b) and (b)'. The input alternating current is converted into direct current through the full wave rectification of diodes (5) ~ (8) and the smoothing of condensers (9) and (10), and a 290V (200V × 2) direct current voltage is generated between connection points p and n in this case as well.

In the same manner as with the 100V power supply alternating current, direct current output is fed to the arc load by transistors (13) and (14), transformer (15), diodes (17) and (18), reactor (19), and detector (22) and driver circuit (23).

Moreover, as switch (4) is switched to contact point (b)', an alternating current with the same voltage as in the case of the 100V power supply alternating current is generated in the secondary winding (25b). Rated voltage output alternating current is fed to driver circuit (23), driver circuit (23) operates normally.

The starting and stopping of the control of transistors (13) and (14) by driver circuit (23) are controlled based on the contact signals of the activation and stopping operations of switch (24), and the feeding of direct current to the load is controlled.

Moreover, conventional arc power supplies that are established as constant voltage controlled direct current power supply devices are usually formed using a voltage detector in place of detector (22) in Figure 2.

(Problems to be Solved by the Invention)
Incidentally, in the case of the aforementioned conventional arc power supply device, it is necessary to switch operation switches such as switches (3) and (4) in accordance with the voltage of the input alternating current, and troublesome operations are required. In addition, in the case of 200V input alternating current, for example, there is the problem that if switches (3) and (4) are mistakenly switched to (a) and (a)', each circuit part of the device will be damaged by high input voltages.

Moreover, in the case of 100V input alternating current, double voltage rectification is performed with a condenser input type structure, and at this time, only the nearly positive and negative peak level portions of the sinusoidal input alternating current are used after flowing through condensers (9) and (10) based on the charging and discharging of the condensers. Even if it is converted into high frequency direct current and the conversion efficiency is increased, it is not possible to feed a sufficient current to the arc device at the time of input of a low capacity 100V single phase alternating current power supply, for example, and the power efficiency of the device that includes the power supply device becomes low. Furthermore, there is also the problem that distortion occurs in the input alternating current waveforms, having a negative effect on other devices that operate using the same alternating current power supply.

The objective of the present invention is to provide an arc power supply device that improves the operationality by omitting switching operations corresponding to the voltage of input alternating current, improves the utilization efficiency of input alternating current, and eliminates the distortion of input alternating current waveforms.

(Means for Solving the Problems)

Means for achieving the aforementioned objectives will be explained hereafter with reference to Figure 1, which corresponds to an embodiment of the invention.

The present invention provides an arc power supply device equipped with:

rectifier (26) as an input rectifying unit that rectifies input alternating current and converts it into direct current;

reactor (27) and switching transistor (28) as a semiconductor switching element that are established in series between the direct current output terminals of said input rectifier (26);

smoothing condenser unit (30) into which the voltage of the connection point of said reactor (27) and said transistor (28) is inserted through a backflow prevention diode (29);

high frequency converting unit (31) that converts the smooth output of said smoothing condenser unit (30) into high frequency alternating current;

output rectifying/smoothing unit (32) that rectifies and smoothens said high frequency alternating current and feeds it into the arc load;

voltage detector (33) that detects the smooth voltage of said condenser unit (30), and;

active filter control circuit (34) as a control unit that feeds drive signals for high frequency switching to said transistor (28) based on the detector signals and reference signals of said detector (33), and regulates said smooth voltage to a constant voltage.

(Operation)

Therefore, the switching frequency of transistor (28) varies based on the detector signals of detector (33) as well, and the smooth voltage of condenser unit (30) is regulated to a constant voltage. The smooth voltage is held at a constant voltage regardless of the voltage of the input alternating current, and direct current output is fed to the arc load by the operations of converting unit (31) and rectifying/smoothing unit (32) based on the smooth output of this constant voltage as well.

Due to the charging and discharging of reactor (27) based on the high frequency switching of transistor (28) as well, the stored energy of reactor (27) is then added to the rectified output of rectifier (26) and is repeatedly fed to condenser unit (30). The charging of condenser unit (30) is repeated during the entire period of the input alternating current, and the utilization efficiency of the input alternating current thus improves.

Furthermore, the input alternating current constantly flows within the device through rectifier (26) due to the high frequency switching of transistor (28), and the distortion of input alternating current waveforms is thus prevented.

(Embodiments)
Next, the present invention will be explained in detail with reference to Figure 1, which shows 1 embodiment of the invention.

In Figure 1, symbols that are the same as in Figure 2 represent the same components as in Figure 2. (26) is a rectifier that rectifies the input alternating current of input terminals (1) and (2), and it is made from a full wave or half wave diode rectifier. This forms an input rectifying unit, and it outputs rectified output with sizes corresponding to the input alternating current from the positive and negative output terminals (+) and (-). (27) and (28) are a reactor and an NPN-type switching transistor, respectively, which are established in series between the output terminals (+) and (-). The collector of transistor (28) that forms a semiconductor switching element is connected to the output terminal (+) through reactor (27), and the emitter of transistor (28) is connected to the output terminal (-) through current detector (35). (36) is a condenser for surge absorption that is established in parallel in the series circuit of reactor (27), transistor (28), and detector (35).

(29) is a backflow prevention diode that is connected to the connection point of reactor (27) and the collector of transistor (28). (37) and (38) are 2 condensers for smoothing that form smoothing unit (30), and they are established in series between the cathode of diode (29) and the emitter of transistor (27). The connection point P of the cathode of diode (29) and condenser (37) is connected to the collector of transistor (13), and the connection point N of condenser (38) and the emitter of transistor (27) is connected to the emitter of transistor (14). (34) is a voltage detector that is established between connection points P and N, and it outputs voltage detector signals that are proportional to the smooth voltage between connection points P and N.

(39) is a DC/DC converter circuit to which the smooth output of smoothing unit (30) that is generated between connection points P and N is fed, and it feeds a drive direct current to an inverter drive circuit and an active filter control circuit, which will be described below. (34) is an active filter control circuit for the drive control of transistor (28), and it is comprised of a digital control circuit that is driven by the electricity supplied from converter circuit (39). This control circuit (34) feeds high frequency switching drive signals with changing frequencies to the base of transistor (28) during the "on" period in accordance with the differences between the voltage detector signals of detector (33) and the constant voltage control reference signals that are internally configured, and based on comparisons of the current detector signals of detector (35) and the internally configured overload reference signals, it restricts the "on" periods or frequencies of switching drive signals to ranges for which transistor (28) does not become overloaded.

(40) is an inverter drive circuit that is established in place of driver circuit (23) in Figure 2, and together with transistors (13) and (14), transformer (15), and detector (22), it forms a feedback control high frequency converting unit (31). This is driven by electricity supplied from converter circuit (39), and operates in the same manner as driver circuit (23) to output drive signals to transistors (13) and (14). (32) is an output rectifying/smoothing unit formed by diodes (17) and (18) and reactor (19). This rectifies and smoothens the high frequency alternating current of converting unit (31), and feeds constant current controlled direct current to the object to be processed (20) and torch electrode (21) arc load.

The 100V or 200V power supply alternating current that is inputted into input terminals (1) and (2) is then rectified with rectifier (26), and at this time, rectified output that is proportional in size to the power supply alternating current – that is, the input alternating current – is generated between the output terminals (+) and (-).

Moreover, transistor (28) switches at high frequencies that are sufficiently higher than the power supply alternating current due to the drive signals of control circuit (34). During the "on" period of transistor (28), rectified output current flows into transistor (28) through reactor (27), and energy with polarity in the direction of the arrow shown in the figure is accumulated in reactor (27). [Continued on the next page]

[Continued from the previous page] During the "off" period of transistor (29) [*sic*], a voltage with the opposite polarity is generated in reactor (27) based on the accumulated energy, and at this time, condensers (37) and (38) are charged by a high voltage, which is formed by adding the voltage of reactor (27) to the rectified output voltage, during periods when the input alternating current is not at positive or negative peak values –even during periods in which it is near the zero-cross voltage, for example.

The rectified output is then smoothened by condensers (37) and (38), and smooth output is fed to converting unit (31) and converter circuit (39) from condenser unit (30).

Incidentally, the voltage between both ends of condensers (37) and (38) – in other words, the smooth voltage between connection points P and N – is detected with detector (33), and voltage detector signals that are proportional to the smooth voltage are outputted from detector (33) to control circuit (34).

Control circuit (34) then digitally increases the error of the detector signals of detector (33) and the smooth constant voltage control reference signals. In order for the detector signals to agree with the reference signals, the "on" periods and frequencies of the drive signals to transistor (28) are varied by pulse-width modulation or frequency modulation, and the feedback of smooth output voltage is regulated to a constant voltage within a range for which components such as transistors (13) and (14) are not damaged.

Therefore, regardless of whether the input alternating current is a 100V or 200V power supply alternating current, the rectified output that is inputted into condenser unit (30) such that the smooth voltage becomes a constant voltage is filter-restricted by control circuit (34), and the smooth output that is outputted from filter unit (30) to converting unit (31) – in other words, the direct current output voltage – is held at a constant voltage.

Moreover, in order to prevent the damaging of transistor (28) due to overcurrent, detector signals of detector (35) are inputted into control circuit (34) along with the detector signals of detector (33). Based on digital comparisons of the detector signals of detector (35) – in other words, detector signals that are proportional to the rectified output current – and the overcharge reference signals, the variability of the "on" periods and frequencies of the drive signals of transistor (26) is restricted such that the current that flows through transistor (28) does not exceed the current values of the reference signals.

Constant current controlled direct current is fed to the arc load due to the operations of converting unit (31) and rectifying/smoothing unit (32). At this time, regardless of whether the voltage of the input alternating current is 100V or 200V, components such as converting unit (31) and rectifying/smoothing unit (32) will not be damaged.

Moreover, based on the high frequency switching of transistor (28) and the discharge of the stored energy of reactor (27), condensers (37) and (38) are repeatedly charged and an input alternating current is used, even in portions other than those in which the input alternating current is close to positive or negative peak values. The utilization efficiency of the input alternating current thus improves, and the power efficiency of the arc device also improves.

Furthermore, based on the high frequency switching of transistor (28), the input alternating current constantly flows within the device through rectifier (26), and the distortion of input alternating current waveforms and adverse effects on other devices are thus prevented.

In the embodiment described above, the case in which a 100V or 200V power supply alternating current is inputted as input alternating current was explained, but the present invention can, of course, be applied to cases in which 2 types of alternating currents that differ from those of this embodiment – for example, 200V or 400V alternating currents – or 3 or more types of alternating currents are inputted as input alternating currents.

Moreover, the direct current that is fed to the arc load is constant current controlled in the embodiment described above, but it is also possible, for example, to establish a voltage detector in place of detector (22) and regulate the direct current to a constant voltage.

Furthermore, the structure of each unit is not limited to the structures of this embodiment – for example, a semiconductor switching element other than a switching transistor may be used as the semiconductor switching element.

The present invention can, of course, be applied to the direct current power supply devices of various arc devices such as arc welding machines, arc cutting machines, and arc lamps.

(Effect of the Invention)
As described above, through the present invention, the smooth voltage of the smoothing condenser unit is constant voltage controlled by controlling the high frequency switching of the semiconductor switching element, regardless of the voltage of the input alternating current. Switching operations corresponding to the voltage of the input alternating current are omitted, making it possible to improve operationality. Furthermore, the stored energy of the reactor is used to charge the smoothing condenser unit during the entire period of the input alternating current, making it possible to improve the utilization efficiency of the input alternating current and improve the power efficiency of arc devices containing the device.
[Continued on the next page]

[Continued from the previous page] Moreover, the present invention is able to prevent the distortion of input alternating current waveforms and prevent adverse effects on other devices.

4. Brief Description of the Drawings
Figure 1 is a block schematic diagram of 1 embodiment of the arc power supply device of the present invention, and Figure 2 is a block schematic diagram of a conventional arc power supply device.

(26)... rectifier
(27)... reactor
(28)... switching transistor
(29)... backflow prevention diode
(30)... smoothing condenser unit
(31)... high frequency converting unit
(32)... output rectifying/smoothing unit
(33)... voltage detector
(34)... active filter control circuit

Representative Patent Attorney Ryutaro Fujita

Figure 1
[see source for figure]

22, 35... current detectors
26... rectifier
27... reactor
28... switching transistor
29... backflow prevention diode
30... smoothing condenser unit
31... high frequency converting unit
32... output rectifying/smoothing unit
33... voltage detector
34... active filter control circuit
39... DC/DC converter circuit

Figure 2
[see source for figure]

22… current detector

23… inverter drive circuit

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審査請求　未請求　請求項の数 1　（全7頁）

㊿発明の名称　アーク電源装置

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㉒出　願　昭63(1988)2月25日

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最終頁に続く

明　細　書

1　発明の名称

アーク電源装置

2　特許請求の範囲

①　入力交流を整流して直流に変換する入力整流部と、

る制御部と

を備えたことを特徴とするアーク電源装置。

3　発明の詳細な説明

〔産業上の利用分野〕

本発明は、電圧の異なる複数の入力交流で駆動

整流する4個のダイオードであり、ダイオード(5)のカソード及びダイオード(6)のアノードが入力端子(1)に接続され、ダイオード(7)のカソードがダイオード(6)のカソードに接続され、かつ、ダイオード(7)のアノード，ダイオード(5)のアノードにダイオード(8)のカソード，アノードそれぞれが接続されるとともに、ダイオード(7)のアノード，ダイオード(8)のカソードの接続点がスイッチ(3)の接点(b)に接続され、100Vの倍電圧整流及び200Vの全波整流を行なう入力側整流器を形成している。

(9)，(10)は直列接続された平滑用の2個のコンデンサであり、両コンデンサ(9)，(10)の直列回路がダイオード(7)，(8)の直列回路に並列に設けられ、かつ、両コンデンサ(9)，(10)の接続点がスイッチ(3)の接点(a)に接続されている。(11)，(12)はコンデンサ(9)，(10)それぞれに並列に設けられた均圧用の2個の抵抗であり、コンデンサ(9)，(10)とともに入力側平滑回路を形成している。

(13)，(14)はNPN型の2個のスイッチングトランジスタであり、トランジスタ(13)のエミッタ，トランジスタ(14)のコレクタが接続され、かつ、トランジスタ(13)のコレクタがダイオード(6)，(7)のカソードの接続点pに接続されるとともに、トランジスタ(14)のエミッタがダイオード(5)，(8)のアノードの接続点nに接続されている。

(15)は1次巻線(15a)及び中間タップ付き2次巻線(15b)を備えた高周波出力用の変圧器であり、1次巻線(15a)の一端が直流除去用のコンデンサ(16)を介してトランジスタ(13)，(14)の接続点に接続されるとともに、1次巻線(15a)の他端がコンデンサ(9)，(10)の接続点に接続されている。

(17)，(18)は出力側整流器を形成する2個のダイオードであり、アノードが2次巻線(15b)の両端それぞれに接続されている。(19)は一端がダイオード(17)，(18)のカソードに接続された平滑用のリアクトル、(20)はリアクトル(19)の他端に接続された被処理物、(21)は被処理物(20)とともにアーク負荷を形成するトーチ電極であり、電流検出器(22)を介して2次巻線(15b)の中間タップに接続されている。

(23)はトランジスタ(13)，(14)のベースに1～20KHzの高周波スイッチングの駆動信号を出力するインバータ駆動回路であり、起動スイッチ(24)の接点信号及び検出器(22)の電流検出信号が入力され、スイッチ(24)の接点信号にもとづき、トランジスタ(13)，(14)の駆動制御の開始，終了が制御され、かつ、検出器(22)の検出信号にもとづき、トランジスタ(13)，(14)のスイッチングを制御してアーク負荷を流れる負荷電流を定電流にフィードバック制御する。

(25)は中間タップ付き1次巻線(25a)及び2次巻線(25b)を備えた駆動回路(23)の電源用変圧器であり、1次巻線(25a)の中間タップ，一端がスイッチ(4)の接点(a)′，(b)′それぞれに接続されるとともに1次巻線(25a)の他端が入力端子(2)に接続され、かつ、2次巻線(25b)の両端が駆動回路(23)に接続されている。

そして、入力端子(1)，(2)に供給される入力交流の100V，200Vにもとづき、予め、手動操作によつてスイッチ(3)，(4)が接点(a)，(a)′又は接点(b)，(b)′に切換えられる。

すなわち、入力交流が100Vの電源交流の場合は、スイッチ(3)，(4)が接点(a)，(a)′に切換えられ、入力交流がダイオード(5)，(6)及びコンデンサ(9)，(10)の全波型2倍電圧整流により、倍電圧整流されて直流に変換され、接続点p，n間に(100V×$\sqrt{2}$×2≒)290Vの直流電圧が発生する。

そして、接続点p，n間の直流電圧がトランジスタ(13)，(14)の直列回路に印加されるとともに、駆動回路(23)の駆動信号によつてトランジスタ(13)，(14)が相互に逆に高周波スイッチングし、コンデンサ(16)を介して1次巻線(15a)に高周波電圧が印加される。

さらに、1次巻線(15a)の高周波の印加電圧にもとづいて2次巻線(15b)に高周波交流が誘起されるとともに、2次巻線(15b)の高周波交流がダイオード(17)，(18)，リアクトル(19)によつて整流，平滑され、被処理物(20)，トーチ電極(21)のアーク負荷に直流出力が供給される。

また、アーク負荷を流れる負荷電流が検出器(22)によつて検出され、検出器(22)から駆動回路(23)に負荷電流に比例した検出信号が出力される。

ところで、駆動回路(23)は2次巻線(25b)の出力交流にもとづいて動作し、スイッチ(24)の起動操作の接点信号の入力により、トランジスタ(13)，(14)の駆動制御を開始する。

そして、検出器(22)の検出信号が内部設定された基準信号に一致するように、駆動回路(23)がトランジスタ(13)，(14)のスイッチング周波数を制御し、負荷電流が定電流にフィードバック制御される。

一方、入力交流が200Vの電源交流の場合は、スイッチ(3)，(4)が接点(b)，(b)'に切換えられ、入力交流がダイオード(5)～(8)の全波整流及びコンデンサ(9)，(10)の平滑によつて直流に変換され、この場合も、接続点p，n間に(200V×$\sqrt{2}$≒)290Vの直流電圧が発生する。

そして、トランジスタ(13)，(14)，変圧器(15)，ダイオード(17)，(18)，リアクトル(19)及び検出器(22)，駆動回路(23)により、100Vの電源交流の場合と同様にしてアーク負荷に直流出力が供給される。

また、スイッチ(4)が接点(b)'に切換えられることにより、2次巻線(25b)に100Vの電源交流の場合と同一電圧の交流が発生し、駆動回路(23)に定格電圧の出力交流が供給され、駆動回路(23)が正常に動作する。

なお、スイッチ(24)の起動操作及び停止操作の接点信号にもとづき、駆動回路(23)によるトランジスタ(13)，(14)の制御の開始及び停止が制御され、負荷の直流供給が制御される。

また、定電圧制御型の直流電源装置として設けられる従来のアーク電源装置は、ほぼ第2図の検出器(22)を電圧検出器に置き換えて形成されている。

〔発明が解決しようとする課題〕

ところで、前記従来のアーク電源装置の場合、入力交流の電圧に応じてスイッチ(3)，(4)などの操作スイッチを切換える必要があり、煩しい操作を要するとともに、たとえば200Vの入力交流の場合にスイッチ(3)，(4)を接点(a)，(a)'に誤切換えすると、高い入力電圧によつて装置の各回路部が破損する問題点がある。

また、100Vの入力交流の場合、コンデンサインプット型の構成で2倍電圧整流が行われ、このとき、コンデンサの充，放電にもとづき、正弦波形の入力交流のほぼ正，負のピークレベル部分のみがコンデンサ(9)，(10)を流れて用いられ、高周波交流に変換して変換効率を高めても、たとえば容量の小さな100Vの単相交流電源の入力時には、十分な直流をアーク機器に供給できず、電源装置を含めた機器の力率が低くなる問題点があり、しかも、入力交流の波形歪みが生じ、同一の交流電源で動作する他の機器に悪影響を与える問題点がある。

本発明は、入力交流の電圧に応じた切換操作などを省いて操作性を向上するとともに、入力交流の利用効率の向上及び入力交流の波形歪みの解消を図るようにしたアーク電源装置を提供することを目的としている。

〔課題を解決するための手段〕

前記目的を達成するための手段を、実施例に対応する第1図を参照して以下に説明する。

本発明は、入力交流を整流して直流に変換する入力整流部としての整流器(26)と、

前記整流器(26)の直流出力端子間に直列に設けられたリアクトル(27)及び半導体スイッチング素子としてのスイッチングトランジスタ(28)と、

前記リアクトル(27)と前記トランジスタ(28)との接続点の電圧が逆流防止用のダイオード(29)を介して注入される平滑コンデンサ部(30)と、

前記平滑コンデンサ部(30)の平滑出力を高周波交流に変換する高周波変換部(31)と、

前記高周波交流を整流，平滑してアーク負荷に供給する出力整流平滑部(32)と、

前記コンデンサ部(30)の平滑電圧を検出する電圧検出器(33)と、

前記検出器(33)の検出信号と基準信号とにもとづき前記トランジスタ(28)に高周波スイッチング用の駆動信号を供給し，前記平滑電圧を定電圧制御する制御部としてのアクティブフィルタ制御回路(34)と

を備えたことを特徴とするアーク電源装置を提供するものである。

〔作　用〕

したがつて、検出器(33)の検出信号にもとづき、トランジスタ(28)のスイッチング周波数が可変されてコンデンサ部(30)の平滑電圧が定電圧制御され、入力交流の電圧によらず、平滑電圧が一定電圧に保持され、該一定電圧の平滑出力にもとづき、変換部(31)，整流平滑部(32)の動作によつてアーク負荷に直流出力が供給される。

そして、トランジスタ(28)の高周波スイッチングにもとづくリアクトル(27)の充，放電により、整流器(26)の整流出力にリアクトル(27)の蓄積エネルギーが重畳されてコンデンサ部(30)にくり返し注入され、入力交流の全期間にコンデンサ部(30)の充電がくり返されて入力交流の利用効率が向上する。

しかも、トランジスタ(28)の高周波スイッチングによつて入力交流が整流器(26)を介して常時装置内を流れ、入力交流の波形歪みが防止される。

〔実施例〕

つぎに、本発明を、その1実施例を示した第1図とともに詳細に説明する。

第1図において、第2図と同一記号は同一のものを示し、(26)は入力端子(1)，(2)の入力交流を整流する整流器であり、全波又は半波のダイオード整流器からなり、入力側整流部を形成し、入力交流に応じた大きさの整流出力を正，負出力端子(+)，(−)から出力する。(27)，(28)は出力端子(+)，(−)間に直列に設けられたリアクトル，NPN型のスイッチングトランジスタであり、半導体スイッチング素子を形成するトランジスタ(28)のコレクタがリアクトル(27)を介して出力端子(+)に接続されるとともに、トランジスタ(28)のエミッタが電流検出器(35)を介して出力端子(−)に接続されている。(36)はリアクトル(27)，トランジスタ(28)，検出器(35)の直列回路に並列に設けられたサージ吸収用のコンデンサである。

(29)はアノードがリアクトル(27)とトランジスタ(28)のコレクタとの接続点に接続された逆流防止用のダイオード、(37)，(38)は平滑部(30)を形成する平滑用の2個のコンデンサであり、ダイオード(29)のカソードとトランジスタ(28)のエミッタとの間に直列に設けられ、ダイオード(29)のカソードとコンデンサ(37)との接続点Pがトランジスタ(13)のコレクタに接続され、コンデンサ(38)とトランジスタ(28)のエミッタとの接続点Nがトランジスタ(14)のエミッタに接続されている。(33)は接続点P，N間に設けられた電圧検出器であり、接続点P，N間の平滑電圧に比例した電圧検出信号を出力する。

(39)は接続点P，N間に生じた平滑部(30)の平滑出力が供給されるDC/DCコンバータ回路であり、後述のインバータ駆動回路及びアクティブフィルタ制御回路に駆動直流を供給する。(34)はトランジスタ(28)の駆動制御用のアクティブフィルタ型制御回路であり、コンバータ回路(39)からの給電によつて駆動されるデジタル制御回路からなり、検出器(33)の電圧検出信号と内部設定された平滑電圧の定電圧制御基準信号との差分に応じてオン期間又は周波数が変化する高周波のスイッチング駆動信号をトランジスタ(28)のベースに供給するとともに、検出器(35)の電流検出信号と内部設定された過負荷基準信号との比較にもとづき、スイッチング駆動信号のオン期間又は周波数をトランジスタ(28)が過負荷状態にならない範囲に制限する。

(40)は第2図の駆動回路(23)の代りに設けられたインバータ駆動回路であり、トランジスタ(13)，(14)，変圧器(15)，検出器(22)などとともにフィードバック制御型の高周波変換部(31)を形成し、コンバータ回路(39)からの給電によつて駆動され、駆動回路(23)と同様に動作してトランジスタ(13)，(14)に駆動信号を出力する。(32)はダイオード(17)，(18)及びリアクトル(19)が形成する出力整流平滑部であり、変換部(31)の高周波交流を整流，平滑し、被処理物(20)，トーチ電極(21)のアーク負荷に定電流制御された直流を供給する。

そして、入力端子(1)，(2)に入力された100V又は200Vの電源交流は整流器(26)で整流され、このとき、出力端子(+)，(−)間には、電源交流すなわち入力交流に比例した大きさの整流出力が生じる。

また、制御回路(34)の駆動信号により、トランジスタ(28)が電源交流より十分高い周波数で高周波スイッチングし、トランジスタ(28)のオン期間には、リアクトル(27)を介してトランジスタ(28)に整流出力の電流が流れ、リアクトル(27)に図示の矢印方向の

極性のエネルギーが蓄積され、トランジスタ(28)のオフ期間には、蓄積されたエネルギーにもとづいてリアクトル(27)に逆極性の電圧が発生し、このとき、整流出力の電圧にリアクトル(27)の電圧を重畳した高い電圧により、入力交流の正，負のピーク値以外の期間，たとえばゼロクロス電圧付近の期間であつても、コンデンサ(37)，(38)が充電される。

そして、コンデンサ(37)，(38)によつて整流出力が平滑され、コンデンサ部(30)から変換部(31)及びコンバータ回路(39)に、平滑出力が供給される。

ところで、コンデンサ(37)，(38)の両端間の電圧，すなわち接続点P，N間の平滑電圧が検出器(33)で検出され、検出器(33)から制御回路(34)に、平滑電圧に比例した電圧検出信号が出力される。

そして、制御回路(34)は検出器(33)の検出信号と平滑電圧の定電圧制御基準信号とをデジタル的に誤差増幅し、検出信号が基準信号に一致するように、パルス幅変調又は周波数変調によつてトランジスタ(28)への駆動信号のオン期間又は周波数を可変制御し、平滑出力の電圧をトランジスタ(13)，(14)などが破損されない電圧内の一定電圧にフィードバック制御する。

したがつて、入力交流が100V，200Vのいずれの電源交流であつても、リアクトル(27)，トランジスタ(28)，制御回路(34)により、平滑電圧が一定電圧になるようにコンデンサ部(30)に入力される整流出力がフィルタ制限され、フィルタ部(30)から変換部(31)に出力される平滑出力，すなわち直流出力の電圧が一定電圧に保持される。

なお、過電流によるトランジスタ(28)の破損を防止するため、制御回路(34)には検出器(33)の検出信号とともに検出器(35)の検出信号が入力され、検出器(35)の検出信号，すなわち整流出力の電流に比例した検出信号と過負荷基準信号とのデジタル比較にもとづき、トランジスタ(28)を通流する電流が基準信号の電流値を超えないように、トランジスタ(28)の駆動信号のオン期間又は周波数の可変が制限される。

そして、変換部(31)，整流平滑部(32)の動作により、アーク負荷に定電流制御された直流が供給され、このとき、入力交流の電圧が100V，200Vのいずれであつても、変換部(31)，整流平滑部(32)などの破損が生じない。

また、トランジスタ(28)の高周波スイッチングとリアクトル(27)の蓄積エネルギーの放出とにもとづき、入力交流の正，負ピーク値付近以外の部分でも、コンデンサ(37)，(38)がくり返し充電されて入力交流が利用され、入力交流の利用効率が向上してアーク機器の力率が向上する。

しかも、トランジスタ(28)の高周波スイッチングにもとづき、整流器(26)を介した入力交流が常時装置内を流れ、入力交流の波形歪みが防止されて他の機器への悪影響が防止される。

なお、前記実施例では、入力交流として100Vと200Vのいずれかの電源交流が入力される場合について説明したが、入力交流として、実施例と異なる2種類の交流，たとえば200Vと400Vの交流のいずれか又は、3種類以上の交流のいずれかが入力される 合に適用できるのは勿論である。

また、前記実施例ではアーク負荷に供給する直流を定電流制御したが、たとえば検出器(22)の代わりに電圧検出器を設け，定電圧制御してもよい。

さらに、各部の構成は実施例に限定されるものではなく、たとえば半導体スイッチング素子としてスイッチングトランジスタ以外の半導体スイッチング素子を用いてもよい。

そして、アーク溶接機，アーク切断機及びアーク灯装置などの種々のアーク機器の直流電源装置に適用できるのは勿論である。

〔発明の効果〕

以上のように、本発明のアーク電源装置によると、半導体スイッチング素子の高周波スイッチングの制御により、入力交流の電圧によらず、平滑コンデンサ部の平滑電圧が定電圧制御され、入力交流の電圧に応じた切換操作を省き、操作性を向上することができるとともに、リアクトルの蓄積エネルギーを利用して入力交流の全期間に平滑コンデンサ部を充電し、入力交流の利用効率を向上して装置を含むアーク機器の力率を向上することができ、しかも、入力交流の波形歪みを防止して

他の機器への悪影響を防止することができるものである。

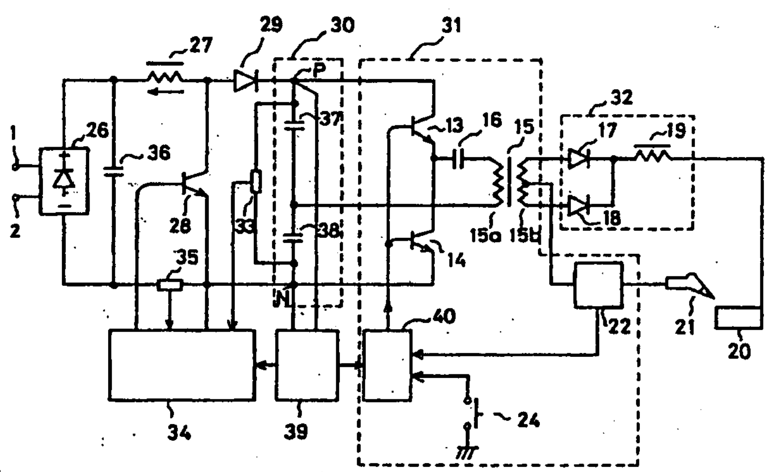
4　図面の簡単な説明

第1図は本発明のアーク電源装置の1実施例のブロック結線図、第2図は従来のアーク電源装置のブロック結線図である。

(26)…整流器、(27)…リアクトル、(28)…スイッチングトランジスタ、(29)…逆流防止用のダイオード、(30)…平滑コンデンサ部、(31)…高周波変換部、(32)…出力整流平滑部、(33)…電圧検出器、(34)…アクティブフィルタ制御回路。

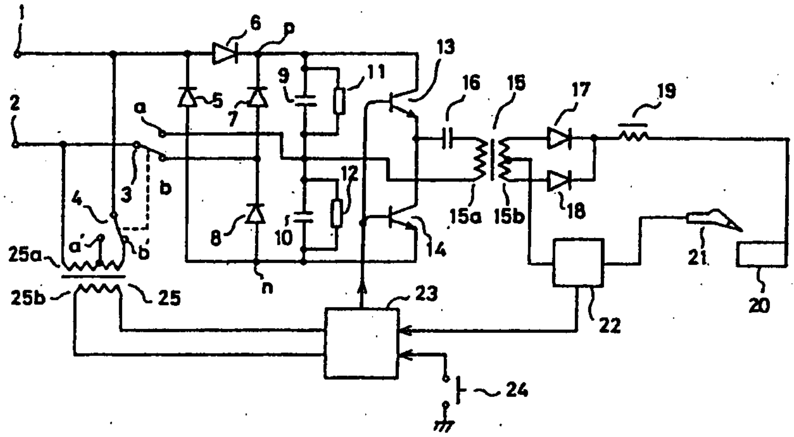
代理人　弁理士　　藤田龍太郎

第1図



22,35---電流検出器
26---整流器
27---リアクトル
28---スイッチングトランジスタ
29---逆流防止用のダイオード
30---平滑コンデンサ部
31---高周波変換部
32---出力整流平滑部
33---電圧検出器
34---アクティブフィルタ制御回路
39---DC/DC コンバータ回路

第 2 図



22---電流検出器　　23---インバータ駆動回路

第1頁の続き

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